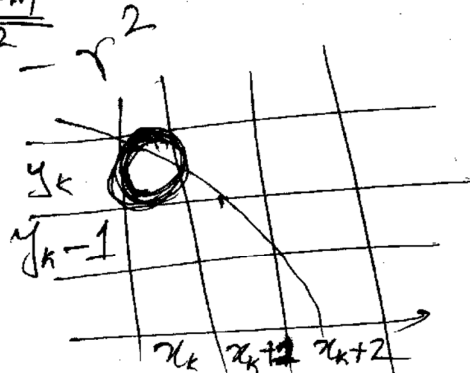




## MIDPOINT CIRCLE ALGORITHM

$$f_{\text{circle}}(x, y) = x^2 + y^2 - r^2$$



@  $x_{k+1}$   $y_{k+1} = y_k$  OR  $y_{k-1}$

We test the function at its midpoint i.e.  $y_k - \frac{1}{2}$

\*  $\therefore$  if  $f(x_{k+1}, y_k - \frac{1}{2}) < 0 \Rightarrow$  Midpoint is inside & hence plot at  $(x_{k+1}, y_k)$

otherwise  $\Rightarrow$  Midpoint is outside & hence plot at  $(x_{k+1}, y_{k-1})$

Let  $P_k = f(x_{k+1}, y_k - \frac{1}{2})$

$$= (x_{k+1})^2 + (y_k - \frac{1}{2})^2 - r^2$$

for iterative reasons

$$P_{k+1} = f(x_{k+2}, y_{k+1} - \frac{1}{2})$$

$$= (x_{k+2})^2 + (y_{k+1} - \frac{1}{2})^2 - r^2$$

$\hookrightarrow y_k$  or  $y_{k-1}$  depends on  $P_k$

see (1)

On solving we get

$$P_{k+1} = P_k + 2(x_k + 1) + (y_{k+1}^2 - y_k^2) - (y_{k+1} - y_k) + 1$$

If  $P_k < 0$   $P_{k+1} = P_k + 2x_{k+1} + 1$

Else

$$\begin{aligned} P_{k+1} &= P_k + 2(x_k + 1) + ((y_k - 1)^2 - y_k^2) \\ &\quad - ((y_k - 1) - y_k) + 1 \\ &= P_k + 2x_{k+1} + \frac{y_k^2}{k} - 2y_k + 1 - \frac{y_k^2}{k} \\ &\quad + 1 + 1 \\ &= P_k + 2x_{k+1} - 2(y_k - 1) + 1 \\ &= P_k + 2x_{k+1} - 2y_{k+1} + 1 \\ &\quad \downarrow \qquad \qquad \downarrow \\ &\quad 2(x_k + 1) \quad - 2(y_k - 1) \end{aligned}$$

$$\begin{aligned} P_0 &= f\left(1, r - \frac{1}{2}\right) \\ &= 1 + \left(r - \frac{1}{2}\right)^2 - r^2 \\ &= \frac{5}{4} - r \\ &\cong 1 - r \quad \text{if } r \text{ is an integer.} \end{aligned}$$

```

#include <stdio.h>
#include<conio.h>
#include <graphics.h>

void plot(int xc,int yc,int x,int y)
{
    putpixel(xc+x,yc+y,WHITE);
    putpixel(xc-x,yc+y,WHITE);
    putpixel(xc+x,yc-y,WHITE);
    putpixel(xc-x,yc-y,WHITE);
    putpixel(xc+y,yc+x,WHITE);
    putpixel(xc-y,yc+x,WHITE);
    putpixel(xc+y,yc-x,WHITE);
    putpixel(xc-y,yc-x,WHITE);
}

void circle_midpoint(int xc,int yc, int r)
{
    int x,y,p;
    x=0;
    y=r;
    plot(xc,yc,x,y);

    p=1-r;
    while(x<y) /*1st octant*/
    {
        x=x+1;
        if(p>=0) y=y-1;

        if(p<0) p=p+2*x+1;
        else p=p+2*(x-y)+1;

        plot(xc,yc,x,y);
    }
}

```

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```
void main()
{
int xc,yc,r;
int gd=VGA,gm=VGAHI;
printf("Feed in the center coordinates & the radius: ");
scanf("%d%d%d",&xc,&yc,&r);
initgraph(&gd,&gm,"\\tc\\bgi");
circle_midpoint(xc,yc,r);
getch();
closegraph();
}
```

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